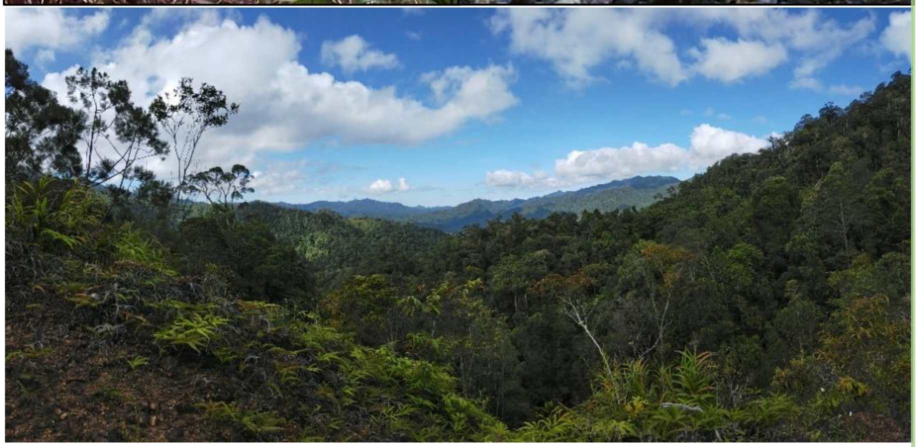
2021

CLIMATE CHANGE RISK ASSESSMENT



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Introduction

This Climate Change Risk Assessment follows the FAO Climate Change Guidelines for forest managers (2013):

The effects of climate change and climate variability on forest ecosystems are evident around the world and further impacts are unavoidable, at least in the short to medium term. Addressing the challenges posed by climate change will require adjustments to forest policies and changes to forest management plans and practices.

Adaptation and mitigation are the two main responses to climate change.

Mitigation addresses the causes of climate change and adaptation its impacts. In the forest sector, adaptation encompasses changes in management practices designed to decrease the vulnerability of both natural forest (NF) and plantation forest, in the form of industrial tree plantations (ITP), to climate change and interventions intended to reduce the vulnerability of people to climate change. Mitigation strategies in the forest sector can be grouped into four main categories: reducing emissions from deforestation; reducing emissions from forest degradation; enhancing forest carbon sinks; and product substitution.

Sustainable forest management (SFM) is consistent with climate change adaptation and mitigation and provides a comprehensive framework that can be adapted to changing circumstances. Efforts to advance towards SFM have provided a wealth of knowledge, experience, best-practice guidance, tools, mechanisms and partnerships that can be applied to help meet climate change challenges and which informs this document. Using SFM as an overall framework helps ensure that adaptation and mitigation measures are synergistic and balanced with other forest management objectives and take into consideration the economic, social and environmental values of forests.

This document provides guidance on what forest managers should consider in assessing vulnerability, risk, mitigation options, and actions for adaptation, mitigation and monitoring in response to climate change.

Recommended actions for climate change adaptation address impacts on:

- forest productivity;
- biodiversity;
- water availability and quality;
- fire;
- pests and diseases;
- extreme weather events;
- sea-level rise;

and economic, social and institutional considerations.

A range of mitigation actions is provided, along with guidance on the additional monitoring and evaluation that may be required in forests in the face of climate change.

Scope of the assessment

This climate change risk assessment was prepared to assess and respond to climate change challenges and opportunities at the forest management unit level of Samling in Sarawak.

Methodology

The approach for Environmental and Social Impact Assessments was used which consists of:

1. identifying the risks;
2. identifying which risks are material / significant to the company, either by their magnitude or if they are legal requirements;
3. identifying risk mitigation measures or adaptive measures and, in a later stage, identifying indicators to monitor implementation.

Results

The analysis is provided in the below table, based on the scope of climate risks identified in the FAO Guidelines.

Climate change impacts and risks	Likelihood	Materiality (Significance)	Recommended (possible) adaptation / mitigation actions	Mitigation and adaptation actions that might be applicable to Samling
FOREST PRODUCTIVITY				
Reduced yields of forest products due to changes in temperature or precipitation	Low	Not material: - yield is related to many different species that will have a different response, - natural forest has a high resilience; -monitor for the future		Monitor research on impact of climate change on yields (e.g. by installed permanent sample plots, by follow up of literature and research projects in Sarawak by the FDS, SFC, WWF, etc.
Increased yields of forest products due to higher temperatures or precipitation	Low	Not material: - yield is related to many different species that will have a different response, - natural forest has a high resilience; - ITP less so; -monitor for the future		

BIODIVERSITY				
Change in the viability of species and varieties in the managed area	Low	Not material: - yield is related to many different species that will have a different response, - natural forest (NF) has a high resilience; - ITP less so; -monitor for the future.		Monitor research on impact of climate change. Measures below related to SFM in tropical forest are already implemented:
			Adjust management plans to take into consideration changes in species distribution (e.g., reduce logging intensities and hunting pressure on affected species)	Monitor for the future
			Manage for diverse tree composition, age and structure and understorey vegetation at the stand and landscape levels	Already applied in natural forest management

			Plant or promote the use of climate-adapted species and varieties	Many potential ITP species all ready trialled
			Establish or expand and manage protected areas to conserve Vulnerable species and habitat types	Significant areas of NF and LPF are protected
			Protect species at the edges of their ranges because they may be better adapted to new climatic conditions	If applicable
			Provide corridors of suitable size and habitat to allow species migration and otherwise maintain landscape connectivity	Natural forest is continuous, no fragmentation
			Assist the movement of species through the restoration and conservation of migration routes and the reintroduction of species	
			Adjust hunting and fishing to levels that are sustainable under new climatic conditions	Hunting and fishing levels are already generally low
			Promote extensive grazing management for livestock to	Not applicable

			prevent overgrazing and encourage regeneration	
Species moving into a management area	Low	Not material: - no invasive species identified in the NF management unit		Monitored in ITP during patrols
			Where appropriate, promote the establishment and management of beneficial species moving into a forest area	Natural forest is continuous, no fragmentation
			Put measures in place to detect and control invasive species	No invasive species
Aquatic species declining	Low	Not material: - low possibility that water level will be so low that aquatic species decline in moist tropical forest areas		
Forest fragmentation	Low	Not material: - no fragmentation by low intensity harvest practices		-

WATER AVAILABILITY AND QUALITY				
Water scarcity/ stress and increased drought	Medium	Not material: - impact might be very long term, but to be monitored		Monitor if changes in forest types, impact if long term droughts occur and their impact on species.
			Sustainably manage water resources to ensure water storage, the regulation of water flow and the provision of water to downstream users (e.g., through the protection of forest catchment areas, water harvesting and the protection of streams)	Measures not applicable to natural forest management, with natural regeneration and diverse natural forest with low intensity harvesting. Water catchments and protected areas are designated in LPFs.
Increased precipitation and changes in seasonal rainfall patterns	Low	Not material: - impact possible, but no direct impact on moist forest		Monitor if changes in forest types
			Adjust harvesting schedules to reduce erosion and siltation, taking into consideration the terrain, forest cover, road networks etc.	Measures not applicable to natural forest management, with natural regeneration and diverse natural forest with low intensity harvesting. ITP will use best applicable practice to reduce erosion.

FIRE INCIDENCE				
Increase in the number, frequency, size or severity of wildfire	High	Material: - climate change can Increase fire incidence (e.g. Fire caused by el niño in 2016)		
			Obtain available information on the increased risk of fire due to climate change (e.g. from research organizations, forestry associations and agencies, and local and regional governments)	Samling is monitoring precipitation at all LPFs. This monitoring will indicate if long, dry periods are occurring and trigger actions in case of prolonged drought (e.g. awareness creation for workers and local communities).
			Assess the impacts of climate change on fire occurrence and behaviour at the landscape level	https://fires.globalforestwatch.org/home/
			Support the development of policies and plans for forest fire management	Classical fire management as applied in other parts of the world is not possible in natural tropical forest, with absence of infrastructure and extensive areas without access. Nevertheless, along existing roads and in the annual logging areas, emergency procedures apply: Warning system, fire-fighting with fire extinguishers or the use of bulldozer, intervention of the fire department in Sarawak for fire caused by shifting cultivation along the roads.

	Ensure the inclusion of integrated fire management in local and regional planning	
	Integrate fire management considerations with forest management planning (e.g. assess the quantities of potential fuel during monitoring to assess fire risk)	
	Establish or improve early-warning and rapid- response systems for fire using electronic e.g. cell phone, radio, television and email) and social media, as well as traditional communication means	Samling records fire incidence..
	Protect fire-sensitive ecosystems through landscape planning and management, with a prevention focus	N.A. in natural tropical forest as all ecosystems are maintain in their original state and low intensive logging has no significant influence.
	Modify landscape structure to impede fire spread (e.g. establish networks of fire breaks; manage for a mix of stand ages and stocking densities; thin stand.;	N.A.: not possible in large area of natural tropical forest. ITP is in mixed aged stands

	Create mosaics of controlled burns; select fire-tolerant species)	N.A.
	Maintain and restore appropriate fire regimes to increase forest resistance to severe fire	N.A.
	Use prescribed burns and "let burn" policies in fire-maintained ecosystems for fuel management and to achieve ecological management objectives	
	Minimize the harmful environmental impacts of fire suppression activities	
	Undertake salvage logging to remove dead or damaged trees that pose a fire risk	
	Promote fire-smart landscapes (e.g. by planting fire-resistant tree species as firebreaks)	Not realistic under Sarawak's conditions
	In production forests, employ reduced impact logging to limit logging gap size and minimize logging damage and waste to reduce vulnerability to fire	Samling does this in NF and ITP
	Reduce or avoid the burning of logging residues in fire-prone areas	There is no authorised burning in NF. Only approved burning is carried out in ITP first rotation.
	In areas where slash-and-burn agriculture poses a fire risk, encourage the modification of	Samling is actively involving local communities, in particular when long term

			burning practices (e.g. restrict burning to seasons where the risk of fire is low)	drought is identified, additional sensitisation activities will be implemented.
			Avoid draining peatlands and other wetlands with organic matter-rich soils	Currently there are only limited areas of ITP planted on peatlands.
			Recognize, respect and promote the use and dissemination of traditional and ancestral fire management practices	Traditionally fire is only used for slash and burn agriculture.
			Monitor methods and techniques for fire management for future planning, and assess the results of these methods	Samling will assess additional possibilities to reduce the fire risk (in particular that through slash and burn agriculture)
PESTS AND DISEASES				
Increased outbreaks of insects, pathogens and invasive native and exotic plant species	low	not material: - no risk of pests in natural tropical forests		To be monitored if any pests might occur, due to climate change impacts

EXTREME WEATHER EVENTS				
Increased flood frequencies and intensities	low	material: - but with low probability (along rivers, impacts on communities and smaller towns)		Measures below can be implemented as indicated:
			Improve early-warning systems and the level of communication among local stakeholders	This is an important function of the government
			Protect headwaters through watershed protection and management interventions	Already implement through SFM and RIL measures and designation of water catchment areas and Terrain Class IV.
			Ensure unimpeded water flows by keeping rivers, creeks and streams free of debris and blockages	RIL measures
			Maintain natural vegetation in riparian zones and avoid the channelization of headwater streams	Protection of river buffer zones/stream buffer reserves
			Design and build infrastructure with larger safety factors (e.g. forest roads with proper drainage and dams with higher storage capacity)	RIL measures

	Ensure the adequate maintenance of road networks, particularly in areas with steep slopes	RIL measures
	Avoid the use of heavy equipment on steep slopes and riparian areas	There is no NF or ITP harvesting in riparian and steep areas areas
	Avoid soil compaction to maintain infiltration rates and the water-storage capacity of the soil	RIL measures
	Adjust rotation lengths and cutting cycles to minimize the risk of storm-induced damage (e.g. landslides or runoff due to reduced vegetation cover)	Natural forest, no intensive impact on the forest structure which is very diverse and adapted to natural disasters. ITP will keep rotation length under review.
	Modify harvesting regimes to improve species and stand stability	In ITP only, not applicable to natural forest
	Avoid clear-cutting in vulnerable areas	Not applicable in NF.
	Maintain or increase species and structural diversity in ecosystems to promote resistance to storm damage and resilience following damage	ITP attempts to plant diverse species. Not applicable in natural forest

			In areas experiencing increased snowfall and ice storms, consider favouring hardwood species over conifers to reduce the risk of breakage from snow / ice	N.A.
			Select wind-resistant species and promote the development of multi-layered canopies	Not applicable, natural forest
Increased likelihood and size of landslides	Low	Not material - no land-slides in the region		-
Increased risk of coastal surges	Low	Not material - no coastal region		-
SEA-LEVEL RISE				
Sea-level rise and storm surges	Low	Not material - no coastal region		-
Food security and livelihoods: changes in food production, access, availability, quality and quantity; poverty exacerbated and livelihoods	Low	Not material - currently no indications that in Sarawak food security will be affected by climate change		To be monitored

negatively affected				
Health: increase in disease; water shortages; malnutrition; fire and smoke-related hazards	Low	Not material: - although there might be an increased fire risk, extent is not estimated to be high due to large areas and low population density)		To be monitored in case of higher fire incidence
Increased pressure on forest resources due to economic decline or decreased land productivity (e.g. for agriculture)	Low	Not material: - land availability is not currently an issue		
Changes in the timing of harvests or duration of harvesting cycles	Low	Not material: - not applied		
Seasonal or permanent migration for employment	Low	Not material: - no seasonal migration. Permanent migration takes place		-

ECONOMIC CONSIDERATIONS				
Heightened risks of economic loss	Medium			-
Changes in policies and markets	High	Material - Payment for Env. Services is necessary to cope with changes and increased costs		
			Be aware of new policies, regulations and financial instruments of relevance to the forest sector that provide financial incentives for climate change mitigation (e.g. REDD+, Clean Development Mechanism, and voluntary carbon markets (VCM)	Samling is aware of new policies.
			Explore existing and new climate change- driven requirements and opportunities (e.g. carbon markets, policy changes and new monitoring and reporting) that may affect forest operations and markets	Idem
			Before engaging in any financial incentive scheme or selling forest carbon, be fully aware of the rules	Samling is already undertaking forest carbon projects & is aware of the rule of engagement

	of engagement and cost implications (e.g. ownership rights to forest carbon)	
	Encourage local and state authorities to support (e.g. through the provision of incentives) the increased production and use of bioenergy through bioenergy plantations and more efficient technology (e.g. improved stoves)	Not applicable in natural humid forest
	Promote the increased use of sustainably produced wood and other forest products as environmentally friendly construction materials and renewable energy sources	Samling is promoting MTCC certified wood
	Advise policy-makers on the benefits of schemes for payments for ecosystem services and encourage them to establish such schemes	Samling advises policy makers, amongst others via Sarawak Timber Association
	Involve users and beneficiaries of ecosystem services in schemes for payments for those ecosystem services and promote local schemes	

	Identify funding for research and development on species that are resilient to climate change	
	Create business models that encourage payments for biodiversity services	
	Remain well informed on policy changes and their implications for forest management through public information sources, direct contact with forestry officials, and forest producer and trade associations	Idem
	Work through forest associations and other means to provide information to policy- makers on the impacts of climate change and climate change policy responses on forest management, with the aim of influencing decision-making	Idem
	Support forest associations in their work on climate change and encourage the strengthening of their capacity in this area	Idem
	Build strategic alliances with relevant stakeholders for benefits	Idem

			related to information dissemination, technical advances and policy representation	
The need to incorporate the results of research on forests and climate change into forest management decisions	Medium	Material - Research is done by IFO/IHC and follow up of external research is material		See actions below:
Access available information and services of forest research and extension agencies and academic institutions; engage with these institutions to encourage relevant and effective research, extension and communication				Samling is undertaking forest carbon projects & is engaged with appropriate sources of information.

Framework for other Mitigation Actions	Mitigation and Adaptation Actions implemented for Samling
Climate change mitigation actions in the land-use sectors fall into two broad categories: reducing GHG emissions by sources (reducing emissions), and increasing GHG removals by sinks (increasing removals of GHGs from the atmosphere).	
Maintaining the area under forest by reducing deforestation and promoting forest conservation and protection;	All natural forest areas managed by Samling are maintained under permanent forest area, with minimal impact by selective logging. ITP areas are only briefly unplanted.
Maintaining or increasing carbon density at the stand and landscape scales by avoiding forest degradation and managing timber production forests so that, on average, carbon stocks remain constant or increase over time; and through the restoration of degraded forests;	All natural forest areas are permanent, and carbon stock can increase in natural forest. ITP areas are only briefly unplanted.
Increasing off-site carbon stocks in harvested wood products (e.g. displacing fossil fuels with wood fuels and replacing construction materials such as concrete, steel, aluminium and plastics with wood).	By the production and use of wood, this is done.
The designation of forests for conservation (specifically as parks and other protected areas) or protection (specifically for the protection of soil and water resources), where timber extraction is prohibited or limited, cannot be considered a mitigation action unless such forests would otherwise have been cleared or degraded.	Samling maintains significant area of both NF and LPF area under protection and conservation.

Forest area can be increased through planting, seeding and assisted natural regeneration, and through natural succession. Afforestation leads to increases in the carbon pools held in aboveground and belowground biomass and in dead organic matter.	No planting, but natural regeneration is used currently.
Activities to maintain or increase stand-level forest carbon stocks include reduced impact logging and sustained-yield management in timber production forests; maintaining partial forest cover and minimizing the loss of the dead organic matter and soil carbon pools by reducing high-emission activities such as soil erosion and slash burning. Replanting after harvesting or natural disturbances accelerates growth and reduces carbon losses relative to natural regeneration. Retaining additional carbon on the site will delay revenues from harvesting, and forest managers should consider carefully the benefits and costs of this approach.	RIL and sustained yield principles are applied.
Another mitigation action is the use of harvested wood products. When wood is transformed into long-lived products, such as buildings and furniture, the products can act as a reservoir of carbon for centuries. While forest managers are generally not involved in energy production or product substitution, they do respond to policy changes and market signals. For example, policies in the European Union to increase the use of biofuels for energy generation are affecting how foresters in the region manage their forests.	By the production and use of wood into downstream products this is done.

Forest managers should consider the various available mitigation options and actions in light of their management objectives, the presence of deforested or degraded land, pressures on the land (e.g. from encroachers or fire), and laws, regulations or other governance factors that affect the range of available land uses and forest management actions	The NF and ITP monitors activities that can negatively affect Climate change.

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Climate Change - Effect on Resource Productivity

Potential Impacts of Climate Change on Samling's Forest Resources in Sarawak, Malaysia, in Terms of Continued Support for Samling's Downstream Operations

Introduction

Climate changes that are predicted to occur over the coming decades have been studied and documented by the Intergovernmental Panel on Climate Change (IPCC 2013). Mean global temperatures have risen by 0.85°C over the period from 1880 to 2012, change which is largely attributed to mankind's emissions of greenhouse gases (IPCC 2014). If such emissions continue at their present rate, which is 'the worst-case scenario', the IPCC predicts that global temperatures will rise by an average of about 4°C by 2100 compared with a 1986–2005 baseline (IPCC 2014). Over shorter time horizons, IPCC has predicted that average temperature in Malaysia (and elsewhere) will rise by at least 1.10 and 1.96 °C by 2030 and 2050 respectively, relative to a 1986–2005 baseline (IPCC, 2014).

Natural Forests

The production areas of Samling's natural forest are confined to the ecological forest type known as the mixed dipterocarp forest (MDF). The Samling production areas in MDF might now[1] be broadly stratified into two altitude zones; this zonation is not strictly determined by a specific geographic contour line. In broad terms the altitude limits of the hill MDF ranges from 300 to 750 m. Above this lies a belt of upper MDF whose upper limit of around 1,250 m merges into the lower montane forest. With increasing altitude there are significant changes in the species composition– both in the dipterocarp component and in that of the non-dipterocarp component. However, in the past this altitudinal change in species composition did not much affect the productive capacity of the forests - it is more of an under-studied ecological fact.

A part of the Sarawak government's forest policy is to move away from dependence on the natural forest as the main support of the wood-based industry and to focus this role on the wood supply from industrial tree plantations (ITP). In supporting this policy Samling has now much reduced its production from the natural forest and developed its ITP base. Indeed, it is probable that before 2030 Samling will have ceased harvesting in the natural forest and will support its downstream operations solely with logs supplied from its ITPs.

Given the above scenario of much reduced to probable cessation of log production from the natural forest, then, whatever the impact of climate change might be on Samling's natural forest production areas in the coming decades, it will be of little or no direct consequence to Samling's downstream operations which will then be supplied by ITP logs.

Industrial Tree Plantations (ITP)

The potential impacts of the above-mentioned predictions of climate changes on the planting domains (i.e., areas environmentally suitable) for Samling's key ITP species in Sarawak (and elsewhere in SE Asia) have been examined in detail in several studies published over recent years

[1] Little lowland MDF now remains as production forest.

in reputable, peer reviewed, international scientific journals (Booth 2013; Booth et al. 2014; Booth et al. 2018; Ouyang et al. 2021). In these and other studies, the potential impacts on planting domains have been examined for average temperature increases of 1.10, 1.96 and 3.83°C by the end of the century (compared against the 1986–2005 baseline used in the IPCC (2013)), corresponding roughly to what might be expected if the implementation of the Paris Agreement is largely effective, partially effective, or largely unsuccessful respectively.

Assuming a ''business as usual'' climate change scenario (i.e., no significant reduction in greenhouse gas emissions) resulting in average temperature increases of 3.83°C by the end of the century, the climate change impacts on Samling's planting domains of key ITP species are expected to be low through to 2030. But impacts will likely become medium by 2050 and high by 2080 if some current ITP sites increasingly start to fall outside the range of conditions known to be climatically suitable for some, but not all, key species (Booth et al. 2014; Booth et al. 2018).

However, if all countries can collaborate to keep global temperature increases below 2°C relative to preindustrial conditions, the vulnerability of the planting domains of Samling's key ITP species – primarily those of the Eucalypts and the Acacias but including *Falcataria moluccana* and *Gmelina arborea* – to long-term climate change is likely to be low.

Even so, it must be understood that predicting the effects of changing environmental conditions on planting domains and yields of ITP species is complex. Changing climatic conditions are likely to not just affect species planting domains, but also the risks of pest, disease and weed problems (Booth et al. 2015), so complex interactions may well produce surprises. Also, climate changes may well result in the productivity of plantations *increasing* at some locations as they start to benefit from atmospheric as well as climatic changes. For example, a study that investigated the effects of increasing temperatures and increased atmospheric carbon dioxide on Acacia plantations in Southern Vietnam estimated that a 2°C temperature rise and a 500 ppm CO2 atmosphere (up from a then level of 360 ppm, compared to recent levels of 400 ppm) could increase growth by up to 20 per cent (Booth et al. 1999).

The overall vulnerability of Samling's key ITP species, such as Gmelina, Falcataria and Eucalyptus and Acacia species, to climate change is a function of potential impact and adaptive capacity (see Booth 2013). Samling has a high degree of adaptive capacity as the plantations are currently grown on short rotations of 6 to 12 years and so the opportunity to change genetic material/species occurs much more frequently than for genera such as Pinus that are often grown in temperate countries on rotations of 30 years or longer. For Samling's plantations, if climate change does start to cause problems, it may be relatively quick and easy for plantation managers to change the genetic varieties or taxa planted to those better suited to higher temperatures. This could be achieved by selecting varieties and clones more tolerant of higher temperatures and/or by introducing genes – through hybridisations – from other closely related species.

Samling's plantation management also has considerable flexibility in management factors other than just species/genotype selection to respond to changes in climatic and other environmental conditions. These include through site selection, stand management (including reducing the impacts of drought), fire management, pest/disease/weed management, establishment strategies and use of more recent climatic data to assess risks (e.g., relying more on climatic data from the last 20 years for planning, rather than long-term mean data based on the last 100 years).

However, the risks from some other environmental effects associated with climatic change could be more problematic – should they materialise. For example, if Borneo were to lose its '*Land*

Below the Wind' status with Sarawak becoming subject to severe tropical storms - such as manifest themselves as cyclones or typhoons in the nearby Philippines - then Samling's ITPs, together with those of all others in Sarawak, would be at significant risk to losses from wind damage in the form of blow and break. As mentioned earlier, Samling operate its ITP on relatively short rotations. Whilst this in no way mitigates the risk itself it does mitigate its effect in that it allows Samling to respond rather more quickly than would be the case in temperate regions where the rotations are considerably longer.

Conclusion

Natural forest: Whilst the changes in climate that have been predicted might well affect various aspects of the productive capacity of Samling's natural forest resource – the hill MDF - this in itself is not a risk factor, as by the time any change of consequence is noted Samling is unlikely to be harvesting any of these areas at a significant level.

Industrial Tree Plantations (ITP): Samling already manages its ITP on short rotations. This has the benefit of allowing relatively rapid change in the planting material used; this in turn should mean that the planting material is better suited to increased temperatures.

More problematic are the possible climate changes that might give rise to a southward drift of the severe tropical storms such as occur in the nearby Philippines. These storms would no doubt result in devastating wind damage. But, again, the short rotation regime would be a distinct advantage. It would allow management to change course at minimum cost although probably with significant, unavoidable disruption to downstream operations.

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